

***Accelerator driven systems:  
Energy generation and  
transmutation of nuclear waste***

***Status report***

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The originating Section of this publication in the IAEA was:

Nuclear Power Technology Development Section  
International Atomic Energy Agency  
Wagramerstrasse 5  
P.O. Box 100  
A-1400 Vienna, Austria

**ACCELERATOR DRIVEN SYSTEMS: ENERGY GENERATION AND TRANSMUTATION  
OF NUCLEAR WASTE. STATUS REPORT**

IAEA, VIENNA, 1997

IAEA-TECDOC-985

ISSN 1011-4289

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Printed by the IAEA in Austria  
November 1997

## FOREWORD

One of the greatest obstacles facing nuclear energy is how to properly handle the highly radioactive waste which is generated during irradiation in reactors. In order for nuclear power to realize its full potential as a major energy source for the entire world, there must be a safe and effective way to deal with this waste. In the past years more and more studies have been carried out on advanced waste management strategy (i.e. actinide separation and elimination) in various countries and at an international level. An innovative concept of a hybrid system for transmutation of long-lived radioisotopes, i.e. the combination of a subcritical nuclear reactor with an high energy particle accelerator, has been suggested recently. It is claimed that accelerator-driven transmutation of waste (ATW), a concept which has been developed in different countries for a period of more than 30 years, offers new prospects for transmutation of high level nuclear waste. The system would convert highly radioactive materials, with half-lives as long as one million years, to non-radioactive materials or materials with much shorter half-lives. In addition, the hybrid system can generate electricity converting transuranium waste.

A Special Scientific Programme on "Use of High Energy Accelerators for Transmutation of Actinides and Power Production" was organized of the IAEA in Vienna on 21 September 1994 in conjunction with the 38th General Conference to present and investigate various technical options for transmutation of actinides and power production using high energy accelerators and to discuss their advantages and disadvantages together with prospects for their technical and economic viability and to understand what could be the role of the IAEA in the further development of this scientific area. Six experts presented their views on key issues of existing concepts and R&D programmes and discussed in depth short and long term perspectives of accelerator driven transmutation concepts.

As recommended by participants of the Special Scientific Programme, the IAEA has initiated work on a status report on accelerator driven systems (ADS). The general purpose of the status report is to provide, in particular for planners, decision makers, and other parties that are not directly involved in the development of ADS, an overview of ongoing development activities, different concepts being developed and their project status, as well as typical development trends.

In November 1994, the IAEA convened a consultants meeting on the status of accelerator driven systems, which brought together experts in this field from France, Japan, the Russian Federation, Sweden and CERN. The purpose was to review the current status of ADS technology and to evaluate the incentives and justifications for this technology in the light of present world energy demands. A draft report based on this review was prepared using input from the experts in areas such as the state of the art in ADS technology, the large scale technical feasibility and the economics of accelerator driven transmutation technology as well as their safety and related environmental aspects. These contributions were reviewed and discussed by the experts at a second consultants meeting and the results of this updated evaluation are summarized in the present TECDOC. This document includes the individual contributions by experts from six countries and two international organizations in many different areas of the accelerator driven systems technology. The report was written during a period of a very dynamic development of different ideas and conceptual designs of the accelerator driven transmutation technology. It is believed, however, that the report gives a comprehensive overview of the most interesting projects which were conducted in that time.

The IAEA would like to thank all those individuals who participated in the consultants meetings, and provided the written contributions from the various countries. Special thanks are due to W. Gudowski from Sweden, who compiled, processed and edited the input from the experts and to C. Rubbia, who provided a comprehensive report on the ADS concept elaborated by CERN. The valuable contributions from the ADTT-division (C. Bowman, F. Venneri and S. Wender) from the Los Alamos National Laboratory are to be acknowledged as well as H. Takahashi's (Brookhaven National Laboratory) invaluable assistance. V. Arkhipov from the IAEA's Division of Nuclear Power and the Fuel Cycle is the officer responsible for preparing this document. The IAEA would like to thank A. Soltan for his help in the final editing of this report.

## EDITORIAL NOTE

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